# Advisory Committee on Energy



## ENERGY IN ONTARIO
## THE OUTLOOK AND
## POLICY IMPLICATIONS

## VOLUME ONE



Ontario

VOLUME ONE

# *SUMMARY OF FINDINGS AND RECOMMENDATIONS FOR THE DEVELOPMENT OF ENERGY POLICY IN FUTURE*

# Advisory Committee on Energy

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TO HIS HONOUR

THE LIEUTENANT GOVERNOR OF THE PROVINCE OF ONTARIO

MAY IT PLEASE YOUR HONOUR:

We, the members of the Advisory Committee on Energy, were appointed by Order in Council dated August 18, 1971, to undertake a comprehensive review to ascertain the future energy requirements and supplies for Ontario, and to make such recommendations concerning policies as are, in the Committee's opinion, necessary to ensure that these requirements will be met. The results of the Committee's deliberations will be transmitted in two volumes. Volume Two, to be submitted shortly, will contain detailed background information as set out in the Table of Contents.

We hereby submit to Your Honour Volume One of our report being the Summary of Findings and Recommendations for the Development of Energy Policy in the Future.

John J. Deutsch
Chairman

December 19, 1972

ONTARIO
PROVINCE OF OPPORTUNITY

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VOLUME TWO

**APPENDICES**

## RECOMMENDATIONS FOR THE DEVELOPMENT OF ENERGY POLICY IN FUTURE

*00:1* Our findings and forecasts show that energy policy will be of major significance to the Government of Ontario in the coming decade. The period of seemingly unlimited abundance and cheap energy has come to a close. The province is facing a greatly changed set of circumstances which may be summarized very briefly as follows:

(1) The effects of the rapid worldwide increase in the use of energy, and in particular, the effects of the energy crisis in the United States, will "spill over" into Canada. This "spill over" has already begun and is having a pronounced effect on Canadian energy developments.

(2) Energy prices are rising on international markets and will undergo continuing increases in the future. The transfer of these price increases into the Canadian market is now underway in the Canadian West. The increases in costs to consumers will be substantial, especially for gas and other clean and convenient fuels.

(3) Environmental problems arising from the expanding use of energy will increase, and intelligent controls and "trade-offs" will be an essential feature of energy policy in the future. Such controls and "trade-offs" will themselves contribute to rising costs, and there will be an increasing need to achieve a reasonable balance between the differing interests and social concerns.

(4) The financial requirements for new energy developments in Canada will be very great – the tar sands, the James Bay project, frontier oil and gas development, northern pipelines. Provincial borrowing for electric power expansion in Ontario will have to compete with other very large requirements for capital elsewhere in Canada.

(5) Ontario is now dependent on sources outside the province for 80 per cent of its energy supplies. Therefore, the relationships with the federal government and other provinces concerning energy is a critical matter which requires urgent attention and clear policy direction by the authorities of Ontario in order to ensure Ontario's interests.

(6) The development of the very large and increasingly costly facilities for the supply of energy involves even longer "lead-times" (seven to ten years) than in the past. Consequently, there is a need for effective and adequate means for long-range policy formulation and planning. The need is immediate.

(7) The rapidly rising world demand for uranium during the next decade has large implications for Ontario. The assurance of Ontario's needs and interests in respect of this highly important indigenous source of primary fuel for the province is a matter of immediate concern.

(8) Much more attention must be given to improving the efficiency with which energy is used and to the conservation of energy. There is a greater need for the coordination of energy use and for the coordination of the forms in which energy is used for various purposes. In the greatly changed circumstances of the future these concerns must have a much higher priority than in the past.

(9) The present widely dispersed responsibilities and largely uncoordinated machinery in regard to energy matters in the Government of Ontario are entirely inadequate for coping with the problems of the future.

*00:2* In order to deal effectively and promptly with these requirements, we recommend that the Government of Ontario accord a high priority to the development of a comprehensive and coordinated energy policy for the province, and to the establishment of the machinery necessary for this purpose. Our studies indicate that the problems of energy policy and administration in the future are of sufficient importance and complexity to warrant the establishment of a separate ministry for energy. Existing government branches and functions dealing with energy would be brought together within the new ministry. This would involve the transfer to the new Ministry of Energy of the appropriate officials and bureaus from half a dozen existing ministries and from numerous other agencies in which the various aspects of energy policy and administration are now dispersed. Unavoidably such transfers would involve a substantial realignment in the existing ministerial structure. Ontario Hydro and the existing Ontario Energy Board would report to the minister of this new ministry. The new ministry would become the means for the application of a consistent policy approach by the government in regard to the whole field of energy in the province. There would be a clearly designated minister responsible for reporting to the Legislature on the whole of this important area of public policy.

*00:3* However, the entire government structure in Ontario has only recently been thoroughly reorganized. We recognize that it may not be advisable or feasible to undertake another major realignment of staff and functions immediately. If this is the case, which of course is beyond our responsibility to judge, we would urge another course of action designed to achieve the same ends. When the timing is more appropriate and as the significance of energy matters has continued to increase, the ministry should be established as recommended above including the transfer of existing functions from other ministries. Many of the functions of the new organization recommended below would then be assigned to the new Ministry of Energy.

A. *00:4* We would recommend the immediate establishment of an Ontario Energy Commission as a *senior* advisory body whose major responsibility would be to develop and make energy policy recommendations to the government. The government would make the necessary decisions and provide for the carrying out of these decisions by its various departments and agencies. The Commission would report to the Provincial Secretary for Resources Development Policy who in turn would report to the Legislature on matters of energy policy and on the work of the Commission.

*00:5* The responsibilities and functions of the Ontario Energy Commission would be as follows:

a) To keep energy matters and energy requirements under constant review with regard to both the immediate and longer future.

b) To make recommendations for the effective coordination of all energy matters within the Ontario Government with a view to ensuring the consistent application of policy in all areas of concern – adequacy of supplies, prices, protection of the environment, health and safety, taxation, franchises, regulations, development of indigenous resources, and land use for energy facilities.

c) To advise and assist the Government of Ontario in its dealings with the federal authorities and the governments of other provinces regarding energy matters.

d) To review, from the standpoint of broad policy, the proposals of Ontario Hydro regarding: i) changes in electric power rates; ii) long-range plans; iii) programs and capital requirements for new electric power facilities; and iv) plans for sources of primary energy including

nuclear power. The Commission would make recommendations on all these matters to the Government of Ontario.*

e) To assume the functions and responsibilities of the present Ontario Energy Board and to carry out immediately the review of gas prices and supplies which must be undertaken to enable arrangements to be made to assure Ontario's needs.

f) To report on any energy matter which is referred to the Commission for study and advice by the Government of Ontario.

g) To foster the development of and to establish priorities for research in all aspects of energy of importance to Ontario, including protection of the environment, conservation, and improved efficiency in the production and use of energy.

h) To prepare an annual report to the Legislature and to the Government of Ontario on the work of the Commission and on the energy position and longer-range outlook in the province.

B. *00:6* With regard to the composition and structure of the Commission, we recommend that:

a) The Ontario Energy Commission be composed of five full-time members, including a chairman and a vice-chairman, appointed at the outset for staggered terms of from five to seven years to provide for continuity. The members should be of senior status and chosen for their qualifications to carry out the highly important duties of the Commission.

b) The Commission be empowered to establish smaller panels from among its members to conduct public hearings for various purposes related to its responsibilities, including gas rate cases and major issues of policy, and to prepare reports on particular matters for the Commission.

*Dr. Robert H. Hay dissents from this sub-paragraph. See Appendix E, p. 36.

c) Provision be made for the appointment of specialized and citizen advisory committees to the Commission consisting of representatives of particular interests in the community concerned with energy matters, i.e., consumers' groups, industrial users, primary energy producers in the province, distributors, and groups concerned with the environment and conservation.

d) The Commission be supported by a relatively small expert staff which is highly qualified to deal with policy and technical problems. The Commission is an advisory and coordinating body and should not become an administrative or operational body – functions which should continue to be performed by the existing ministries and agencies until a new Ministry of Energy is established.

e) The Commission be given authority to secure reports and information from government bureaus and agencies so as to enable the Commission to make recommendations to the government for the coordination of policies and operations, including recommendations for any necessary changes in governmental structures to ensure such coordination and the effective carrying out of policy.

f) If and when the new Ministry of Energy is established the coordinating functions described in paragraph 00:6 d) and the functions described in paragraph 00:6 e) would be assigned to the new ministry along with those functions which will be assumed from the existing ministries relating to energy matters. The Commission would then become primarily an advisory and regulatory body carrying out in particular the functions described in paragraphs 00:5 a), 00:5 d), 00:5 e), 00:5 f), 00:5 g) and those in paragraph 00:6 b).

C. *00:7* Energy policy in the future must comprise the important new dimension arising from the need to protect the environment and the quality of life as material output and population continue to grow. Environmental concerns must occupy an adequate place from the outset in all planning of programs and projects. Accordingly, we recommend that the Government of Ontario through its appropriate agencies implement a policy of requiring the preparation of environ-

mental assessments* of the environmental effects of all proposed programs and projects prior to their implementation, relating to the production, conversion, transportation and use of energy by both public and private bodies. We recommend that the Ontario Energy Commission coordinate the work of government agencies for this purpose, develop guidelines for the implementation of this policy, and advise the Government of Ontario on the considerations involved in achieving a desirable balance between conflicting concerns and objectives.

*Dr. Robert H. Hay dissents from this recommendation. See Appendix E, p. 36.

# SUMMARY OF FINDINGS

## ENERGY AND ECONOMIC GROWTH

*0:1* It can be shown historically, and geographically, that there is a strong correlation between economic growth and energy consumption. This lies in the fact that energy can be economically substituted for human effort. Generally, nations have developed beyond the subsistence level only when individual effort has been supplemented by inanimate sources of energy. Perhaps the best single example of energy substitution occurred in England during the Industrial Revolution, which inaugurated the modern industrial age.

*0:2* Substitution of man-created energy for manpower helps to permit the output of the employed labour force to increase more rapidly than the growth in employment, thus leading to substantially increased productivity. This in turn usually involves greater capital intensity or capital invested per worker. Economic growth and increased energy use are circular in the sense that one begets the other.

*0:3* The rewards from increased productivity are spread through the economy to consumers, governments, investors, etc. and this in turn increases final demand for goods and services. This additional demand includes a rising demand for energy by consumers. In other words, economic development and increased energy consumption go hand in hand and have played an important part in the economic history of Canada and Ontario over the past five decades.

*0:4* Since World War II, real gross domestic product in Canada has increased at an average annual rate of 4.7 per cent while energy consumption has increased at about the same rate, 4.6 per cent. In the United States the comparable figures are close to 4.4 per cent while in Japan, where post war economic expansion had led the world, output of real goods has increased by 9 per cent per annum over the past decade while energy consumption has increased at an annual rate of 12 per cent.

*0:5* While total energy consumption has moved ahead with economic development, the form in which it is consumed, has changed. Coal as a primary energy source has been displaced, first of all, by oil, and latterly, by natural gas. Also, improved standards of living have increased energy consumption in the form of electric power. The modern home in Ontario, for example, is a mass of electricity-using devices, whose primary energy source may be hydro, oil, gas, coal or uranium. The implications of this increased energy use through electric power generated thermally from these primary sources are of key importance to this study, both from the stand-

point of the rapid rise in the use of scarce fossil fuels and the impact of this growth on the environment.

*0:6* While economic development in Ontario has been linked closely with energy consumption, so has been an increasing awareness of the environmental impact of economic growth. Specifically, combustion of coal and certain types of fuel oil have led to increasing levels of air pollution. Greatly increased demands for thermal electric power have also added a great burden of environmental problems such as thermal pollution and stack emissions. Thus, while the effective application of energy has enabled us to improve the quality of life and raise our standard of living, it has at the same time created several unfavourable by-products which must be dealt with effectively and in time.

*0:7* Ontario is a very highly concentrated energy market. Being a highly industrialized province, much of the economic base depends upon intensive energy use. The climate of Ontario, as indeed of most of Canada, is such that energy requirements for space heating are considerable, and account for approximately one-quarter of all energy needs. Also in Canada, and specifically in Ontario, the great distances require substantial inputs of energy for transportation, whether by road, rail or air. Northern Ontario, with its vast developed and potential natural resources also depends very significantly on energy for development. Thus, per capita consumption of energy in Ontario is above the Canadian average and well above the average of most industrialized countries. This means that continued industrial development of the province involving, as it must, increased energy use, poses also the rising threat of increasingly serious environmental impact. One of the major policy issues facing the province will be to achieve an acceptable trade-off between growth and environment, taking into account not only direct economic costs but all social costs as well.

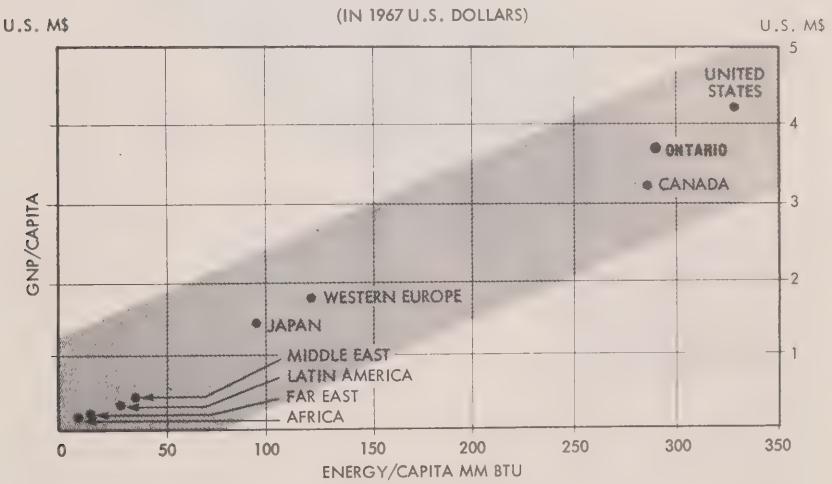
*0:8* In order to become aware of the likely development of the province's future energy economy, the Government of Ontario appointed the Advisory Committee on Energy and requested the Committee to review the energy needs of the province, determine the major areas of concern and recommend the policies which will be necessary to deal with them. To set the stage for a review of Ontario's energy outlook, the first step was to assess the likely path of economic growth and the implications of this growth for energy consumption and for the environment.

*0:9* The Committee did not pursue the issue of economic growth itself. Having pointed out the close relationship between economic growth and the intensity of energy use, it follows that the rate of energy consumption can be influenced by altering the rate of growth. This is a matter which goes beyond the terms of reference of the Committee but further study of the implications of various rates of growth (of which energy consumption is

only one) is warranted. The Committee has illustrated one energy projection based on the trends of economic growth during the past two decades. Energy models can be constructed to correspond with other sets of demand conditions. Thus, while this presentation is based on past trends and in the short-run, a probable projection of energy demand, new policies (such as those to improve use efficiencies and conservation) will give different results depending on the timing and effectiveness of such policies.

Figure 0:1

The Relationship in 1969 Between Per Capita Gross National Product And Per Capita Use of Energy in Various Countries and Regions

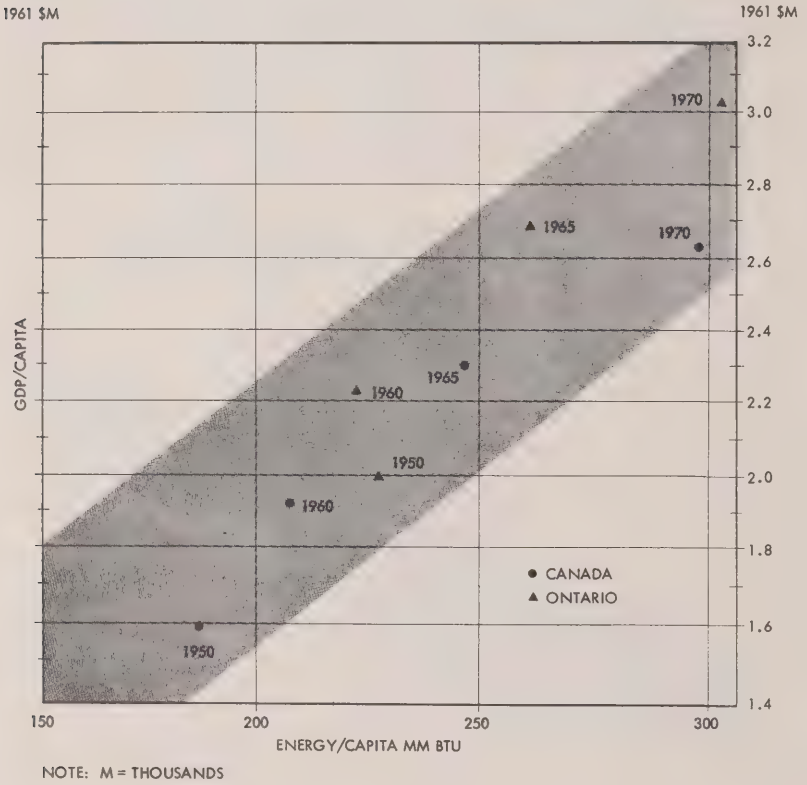



NOTE: M = THOUSANDS

Source: Imperial Oil Limited *Submission to the Advisory Committee on Energy*

Figure 0:2

The Relationship Between Per Capita Gross Domestic Product
And Per Capita Use of Energy in Canada and Ontario for Selected Years




Source: Imperial Oil Limited *Submission to the Advisory Committee on Energy*

## THE ECONOMIC BACKGROUND

*0:10* In order to assess the background against which Ontario's future energy supply and demand must be studied, the Committee has reviewed the economic outlook for the province over the next 20 years. This forecast has concentrated on trend values, and has made no attempt to predict business cycle fluctuations within the two decades.

*0:11* Of importance to the forecast, is a significant slowing down in population growth. The average annual growth rate over the past two decades in Ontario has been 2.7 per cent, while the outlook for the next two decades suggests an average annual growth rate of at most 2 per cent and, quite likely, somewhat less. Several demographic factors explain this slowing down. Postponement of marriage age, birth control, timing of family formation and extension of working women's careers, have all contributed. On the basis of a high assumption of about 2 per cent average growth rate, the Ontario population would be in the neighbourhood of 11 million in 1990.

*0:12* The number of households will continue to increase at a rate in excess of population growth, suggesting a continuing decline in the number of persons per household. By 1990 it is estimated that there will be 3.3 million households in the province, compared to 2.1 million in 1970. There will be a continuing trend towards apartment dwelling.

*0:13* Relating growth in gross domestic product to the anticipated population expansion, per capita gross domestic product is expected to increase at an average annual rate of close to 3 per cent per annum between 1970 and 1990.

*0:14* One particularly sensitive economic indicator, especially when related to energy and environmental implications, is the number of automobile registrations. These increased at an average annual rate of 5.5 per cent between 1950 and 1970, and a significant slowing down is expected in the forecast period to 3.2 per cent for the final decade. Combining population growth and automobile registrations, there should be a continuing increase in the density of automobiles, approaching saturation by 1990 of about 2.26 persons per automobile.

*0:15* From the viewpoint of environmental impact, the number of automobile registrations in the Toronto-Hamilton area presents a major concern. Approximately 900,000 passenger cars were registered in the area in 1971, representing 35 per cent of the provincial total. By 1990 it has been predicted that this number will reach 2 million. The number of registrations in the metropolitan areas could be influenced by such factors as rapid transit facilities, parking restrictions, zoned use, etc. The level of pollution caused by a certain number of vehicles will of course be influenced by their type (e.g.,

electric) or by the fuel used (e.g., liquefied petroleum gases) or by the extent of anti-pollution devices in use.

*0:16* Of great importance is the role of energy in the manufacturing sector. Here, when relating the percentage of fuel and electricity costs to the value of manufacturing shipments, Ontario has a ratio of 1.7 per cent compared to an overall ratio for all Canada of 1.9 per cent. This would imply that the Ontario manufacturing sector is relatively price insensitive to energy costs. These ratios, however, reflect broad averages which in turn conceal individual industries, therefore they must be used with great caution. Also, there are industries where energy commodities, such as oil and gas, are not used in any energy function. For example, the petrochemical industry is a large user of natural gas and liquefied petroleum gases. These are not only used as a fuel but also as feedstock, the raw material for production. Any significant increase in the costs of these commodities, therefore, would greatly affect the viability of the petrochemical group as a whole.

*0:17* Looking at fuels and electricity purchased and consumed by the manufacturing industries in Ontario, in 1970 expenditures for electricity alone amounted to $186 million, accounting for over 44 per cent of all energy expenditures in manufacturing. Natural gas was next in importance at over 23 per cent, followed by fuel oil at 14 per cent. The combined expenditure for coal and coke contributed 8 per cent to total manufacturing energy costs.

*0:18* Having reviewed very briefly the basic economic parameters, the real issues pertaining to this study concern the implications for the demand for and supply of energy. The next stage therefore is to analyse the pattern of energy consumption in the province over the past two decades, relate these to the various technological, sociological and economic changes of the times and from this base try to paint a scenario of the likely energy outlook over the next several decades ahead on the basis of the trends which are now operating. Early in this assessment it became clear that many changes had taken place in the past few years which have significantly affected the pattern of energy consumption and its social impact, especially on the environment.

## ENERGY MEASUREMENT

In North America the most widely used measurement unit in the study of energy has been the British thermal unit (Btu). It is a small unit (the amount of heat required to raise the temperature of a pound of water one Fahrenheit degree) and so will usually be expressed in thousands ($10^3$), millions ($10^6$), billions ($10^9$) and trillions ($10^{12}$).

The Btu equivalents of common fuels are as follows:

| Fuel | Common Measure | Btu |
|---|---|---|
| Crude Oil | Barrel (bbl) | 5,800,000 |
| Natural Gas | Cubic foot (cf) | 1,000 |
| | Thousand cubic feet (mcf) | |
| Coal | Ton | 24 to 28,000,000 |
| Electricity | Kilowatt hour (kWh) | 3,412 |
| | Megawatt (MW) | |

Thermal electric power generation ranges in efficiency from about 30 per cent for a nuclear station to 40 per cent for a modern coal-fired generating station. Thus, for a kilowatt hour of output (3,412 Btu) the energy input will range from 8,500 Btu to 11,000 Btu. The extra Btu are lost as waste heat.

## THE ONTARIO ENERGY BALANCE, 1970-1990

### i) Requirements

*0:19* Between 1950 and 1970, total Ontario energy requirements increased at an average annual rate of 4.2 per cent. Conversion, loss and own use, increased at an average annual rate of 7.7 per cent over the 20-year period. The principal component of this latter group is the thermal loss in electric power generation. It also includes a wide range of energy applications such as refinery fuel, pipeline fuel and losses by both.

Table 0:1

**Ontario Energy Demand By End Use 1950 – 1990**
(Trillion Btu)

| | *Residential & Commercial* | *Industrial* | *Transport-ation* | *Conversion Loss and Own Use* | *Total* |
|---|---|---|---|---|---|
| 1950 | 300 | 330 | 230 | 160 | 1,020 |
| 1960 | 380 | 440 | 250 | 342 | 1,412 |
| 1970 | 625 | 700 | 394 | 631 | 2,350 |
| 1980 | 890 | 1,190 | 640 | 980 | 3,700 |
| 1990 | 1,200 | 1,950 | 1,100 | 1,450 | 5,700 |
| | | (Percentage of total) | | | |
| 1950 | 29.4 | 32.4 | 22.5 | 15.7 | 100.0 |
| 1960 | 26.9 | 31.2 | 17.7 | 24.2 | 100.0 |
| 1970 | 26.6 | 29.8 | 16.8 | 26.8 | 100.0 |
| 1980 | 24.0 | 32.2 | 17.3 | 26.5 | 100.0 |
| 1990 | 21.1 | 34.2 | 19.3 | 25.4 | 100.0 |

*0:20* The technical factors behind these varying energy requirements of the past two decades include the major shift from coal to oil and gas which took place, first from coal in the 1950s and, second, towards gas in the 1960s. These shifts reduced the input requirements of raw energy because of the improved efficiency achieved with the superior fuels.[1] The dieselization of the railroads, the jet engine, oil space heat, all tended to reduce energy *inputs* but, despite these improvements in efficiency, the total energy demand was rising sharply.

[1]Some examples of "net gross" use in major applications – 5 per cent for steam locomotives, 25 per cent for diesel locomotives, 25 per cent for automobiles, 75 per cent for gas space heating, nearly 100 per cent for electric, water and space heating from water power.

*0:21* The outlook for the rest of this decade suggests an overall increase in Ontario energy demand of 4.6 per cent per year. By 1980 total requirements will be 3,700 trillion Btu, close to 60 per cent more than for 1970. By 1990 total requirements are projected to be 5,700 trillion Btu, or nearly two and one-half times the demand for 1970. The above average increases in the industrial and transportation demand for energy reflect the fact that the advantages of improved conversion, which held down the rate of increase in the last two decades, have been utilized and in future the energy requirements for these sectors will reflect more accurately the real growth in demand.

*0:22* A major new influence in the next decade, and beyond, will be the environmental improvement controls which will tend to increase energy consumption. Conversion to lead-free gasoline may require an additional 70 thousand barrels per day in Ontario by 1980. Offsetting this, however, will be a trend towards smaller cars. By the 1980s, new technology such as the Wankel engine and electric cars may become more significant. However, the electric car merely changes the demand from gasoline to the source of the electricity.

*0:23* Much of the transition from the "pre-environmental" to the "post-environmental" era will be accomplished by 1980. Thereafter energy growth rates in the industrial and the transportation sectors might be expected to slow down. However, greatly increased leisure time will maintain strong pressure on demand for transportation in all forms, partially offsetting economies of mass transit and smaller cars. Residential and commercial energy demand will also slow down because the rate of population growth will be declining. Offsetting this, however, will be the increasing role of electric energy in the total energy supply.

*0:24* In 1970, approximately 27 per cent of total energy consumption in Ontario was accounted for by the residential and commercial sector. Of this total, about three-quarters was required for space heating. The remainder was consumed mainly in electrical and gas appliances. Energy demand for air conditioning was negligible (of the order of one per cent).

*0:25* Oil consumption has grown steadily and gas consumption has grown very rapidly for space heating. Electrical resistance heating is presently of the order of one per cent of total fuel use in the sector and coal consumption is small and declining rapidly.

*0:26* The transportation sector accounted for about 17 per cent of total energy consumption in Ontario in 1970. Fuel consumption by motor vehicles in turn accounts for about four-fifths of energy consumed in transportation. It is expected that transportation will continue to account for roughly the same percentage over the forecast period.

*0:27* It is unlikely that the internal combustion engine will be replaced on a broad scale in the near future. Possible alternatives to the internal combustion engine now in the experimental stage, require a great deal of further development. Assessment of changes in energy consumption through technological development must therefore first take account of newly instituted anti-pollution regulations for the internal combustion engine.

*0:28* Other propulsion systems currently under development (although not displacing the internal combustion engine within the critical periods during which rigid environmental protection standards will be introduced) may well come into widespread use. These include gas turbines, external combustion engines, electric cars, improved urban transportation systems and improved long distance freight and passenger movement systems.

*0:29* Development of the storage capacity of batteries has not reached a point which would give the electric car long-range operational capability. Although attempts are being made to develop a battery which would permit a range of at least two hundred miles, it is generally accepted that it will be a number of years before technology will have provided an all-electric substitute for the North American family car at a competitive price. The most logical first application of the electric car would be for the second or downtown car, leaving highway travel for the conventional automobile.

*0:30* Energy input to the industrial sector (primarily the manufacturing sector) presents a very complex picture because of the diversity of applications. Industrial energy requirements include: a) electrical energy for lighting and motive power; b) space heating; and c) energy for a wide variety of specific industrial applications such as process steam production and metallurgical furnaces. Energy demand by industry accounts for one-third of total energy consumption in Ontario, and has grown steadily. However, the demand for specific types of energy is changing rapidly. The use of gas has grown at a fast pace, oil is maintaining its market share and coal is declining significantly. The relative use of electricity is increasing moderately.

*0:31* Five industry groups accounted for more than 70 per cent of total 1970 consumption of energy by Ontario's manufacturing industries. These were: food and beverages; paper and allied products; primary metals; non-metallic minerals; and chemicals and chemical products. Fifteen to twenty years may be necessary for new energy saving processes to be commercially applied throughout the steel industry. Thus, in the primary metals (and the pulp and paper industries), major changes not now in use are unlikely to affect substantially the demand for energy in the next ten years.

In certain types of light industry such as the food industry, technological changes may be made relatively quickly, but major technological changes affecting energy use by industry as a whole are not anticipated in the early future. It is anticipated that at the end of the present decade industry will continue to account for about one-third of total energy consumption in Ontario.

ii) **Supply**

*0:32* Ontario has a wide range of energy supply sources, but about 80 per cent of the supply originates outside the province. In 1950, 22 per cent of Ontario's energy was supplied by oil, and by 1970 this had increased to 40 per cent. A small quantity of natural gas from local fields has always been produced. When a gas supply from western Canada became available, natural gas sales expanded very rapidly and accounted for close to 20 per cent of all energy in the province in 1970. Coal has dropped sharply in significance, falling from more than half of all Ontario energy in 1950 to about 20 per cent in 1970. Water power increased during the 1950s to 25 per cent of the total energy supply but has been declining in relative importance in recent years reaching 18 per cent by 1970. Nuclear power in 1970 accounted for less than one per cent of the Ontario energy supply.

Table 0:2

**Ontario Energy Supply 1950 – 1990**

| | *Oil* (million barrels) | *Natural Gas* (billion cubic feet) | *Coal* (million tons) | *Hydro* (billion kWh) | *Nuclear* (tons $U_3O_8$) |
|---|---|---|---|---|---|
| 1950 | 43 | – | 23 | 18 | – |
| 1960 | 115 | 115 | 13 | 36 | – |
| 1970 | 184 | 440 | 16 | 43 | – |
| 1980 | 288 | 950 | 16 | 38 | 1,030 |
| 1990 | 420 | 1,400 | 15 | 37 | 2,300 |

(Percentage of total)

| | *Oil* | *Natural Gas* | *Coal* | *Hydro* | *Nuclear* | *Other* | *Total* |
|---|---|---|---|---|---|---|---|
| 1950 | 22.1 | 1.2 | 56.9 | 17.6 | – | 2.2 | 100.0 |
| 1960 | 42.6 | 8.1 | 22.7 | 25.8 | – | 0.8 | 100.0 |
| 1970 | 40.7 | 18.7 | 21.3 | 18.3 | 0.6 | 0.4 | 100.0 |
| 1980 | 41.9 | 27.0 | 10.8 | 10.3 | 9.8 | 0.2 | 100.0 |
| 1990 | 38.0 | 25.0 | 6.5 | 6.5 | 23.9 | 0.1 | 100.0 |

*0:33* In 1950 Ontario's energy requirements were relatively simple – 43 million barrels of oil, 23 million tons of coal and 18 billion kilowatt hours of hydro power. There was only a nominal use of natural gas and no nuclear power. By 1970 the picture had changed substantially as shown in Table 0:2, and the stage was set for a new era which will lean more and more on nuclear energy.

*0:34* Looking at the next 20 years, the most significant development will be the sharply increasing role of nuclear energy. Natural gas will increase its share somewhat over the next few years, and should provide about 25 per cent of our energy supply over the next several decades. The contribution of coal will continue to decline sharply. A similar trend in water power will be noted as the available sites in the province have nearly all been developed. The role of nuclear power will increase to about 10 per cent of the energy supply by the end of this decade and to about 25 per cent of our total energy supply by 1990.

*0:35* On a world basis, Canada stands second (with Ontario slightly below the Canadian average) in the per capita use of electric energy. The leading per capita consumers in 1969 were:

| | | |
|---|---|---|
| 1. | Norway | 14,452 kWh |
| 2. | Canada | 8,959 " |
| 3. | *Ontario* | *8,669* " |
| 4. | Sweden | 7,743 " |
| 5. | United States | 7,644 " |
| 6. | New Zealand | 4,697 " |

*0:36* Electricity consumption by market sector in Ontario during 1971 was:

| | *Billions of kWh* | *Percentage* |
|---|---|---|
| Residential (including farm and street lighting) | 16.3 | 22.4 |
| Commercial | 10.0 | 13.7 |
| Industrial (including utility plant use)[2] | 34.4 | 47.2 |
| | 60.7 | 83.3 |
| Losses and unallocated | 12.2 | 16.7 |
| Total | 72.9 | 100.0 |

[2] About one-third of industrial consumption is accounted for by the primary metals and pulp and paper industries.

Demand for electric energy in Ontario has been doubling about every decade, corresponding to an average long-term annual growth rate of about 7 per cent. On the basis of present policies and circumstances this rate of increase is expected to continue into the 1980s.

*0:37* Traditionally, as in other provinces, Ontario has been dependent on hydro-electric power. As recently as 1960, 99 per cent of electric energy generated by Ontario Hydro was by water power. But the number of hydro sites is limited, and steam generating capability was developed very rapidly to meet the growing load requirements. The following table shows the transition from water power and the increasing dependence on steam generation. The use of fossil fuel is expected to peak by 1980 and nuclear power to become the dominant source of electricity by 1985.

Table 0:3

**Primary Fuel as a Percentage of Electricity Produced in Ontario**

| | *Water Power* | *Fossil Fuel* | *Nuclear* |
|---|---|---|---|
| 1960 | 99.4 | 0.6 | 0.0 |
| 1970 | 60.5 | 37.8 | 1.7 |
| 1980 | 27.0 | 44.3 | 28.7 |
| 1990 M* | 13.9 | 28.2 | 57.9 |
| H** | 13.9 | 14.4 | 71.7 |

* moderate nuclear program 1980 to 1990
** high nuclear program 1980 to 1990

*0:38* As the major energy consuming region in Canada, the availability of indigenous energy resources in Ontario is of strategic significance. In recent times the province has been heavily dependent on imported energy although in the late nineteenth century the province had an exportable surplus of oil and gas, shipping some products as far as Europe.

*0:39* In 1970 the province imported approximately 80 per cent of its energy requirements. Local production of petroleum and natural gas now make up only about one per cent of the total energy supply and the contribution of uranium through nuclear power is just beginning to be significant. The most important local energy source, however, is water power which in 1971 was still the major source of electric power generation in Ontario.

*0:40* Little change in the relative provincial contribution to total supplies is expected with the increasing nuclear role merely offsetting the declining role of water power in the total generating system. The energy

supply for the province will continue to respond strongly to events and conditions outside provincial control. It will be influenced very directly by the rapidly changing factors of the North American energy scene and indeed beyond to the similarly rapidly changing factors in the world energy picture, particularly for that critical commodity, oil.

## EXTERNAL FACTORS AFFECTING ENERGY SUPPLY

### i) The World Outlook

*0:41* There is little question that oil is the most strategic energy source in the world today. This fact is based not only upon the volume of oil which moves in international trade, but also on the circumstance that oil accounts for more than 50 per cent of world energy consumption. By 1980 this ratio is expected to approach 60 per cent, implying an average annual growth rate of 6.5 per cent. Canada and Ontario are heavily involved in this international trade pattern.

*0:42* The strategic significance of the trade in crude oil lies in the location of the world's major oil reserves. An estimated 67 per cent of all the world's oil reserves are located in the Middle East, and the world will rely more and more on production from this area. The life index of world oil reserves is currently approximately 38 years but this is likely to drop to about 22 years by 1980 assuming a continuation of recent trends. In the decade of the 1970s the world is expected to consume approximately 200 billion barrels of oil, roughly equivalent to total historic consumption to date and about 40 per cent of today's known oil reserves.

*0:43* Offsetting this consumption is the volume of new discoveries, currently averaging about 29 billion barrels per year. However, including the new discoveries the 1980 reserve index would be reduced to 22 years. This analysis can be extended to the year 1990, when the reserve life index is estimated to decline to 11 years.

*0:44* By 1990 therefore, or in any event before the turn of the century, the world will be faced with the necessity of greatly increasing oil discovery rates or curtailing consumption of crude oil. Both solutions will be sought in varying degrees from one part of the world to another. The energy economy of the province of Ontario will inevitably reflect these mounting world supply stringencies. Over the next two decades, Ontario will be strongly influenced by events which flow from the rapid depletion of the world's known reserves of fossil fuels.

### ii) The United States Outlook

*0:45* The United States energy economy has been described by many commentators as one which is rapidly moving into a "crisis". The pattern of energy consumption in the United States is not substantially different from that of Canada or Ontario. Residential and commercial consumption is relatively less important than in Canada and Ontario, probably because of the climatic difference. Industrial, transportation, and electric utilities each account for approximately one-quarter of total United States energy demand. Over the next two decades the principal change in emphasis will be the increasing role of electric power in United States energy supply, and the rapid growth in thermal generating capability, especially nuclear power. United States energy consumption is expected to increase by an average annual rate of 4.2 per cent over the next 20 years, not substantially different from the outlook for Ontario.

*0:46* The current United States energy problem is primarily one of providing the right kind of energy, in the right form, at the right place. In the short run it is essentially a matter of supply logistics. In the longer run, with the exception of coal, all the principal energy sources have serious problems of one kind or another including rising shortages, but many of these in the short run at any rate are political and social rather than technical. The most dramatic change in United States energy supply will be the greatly increased dependence on imports which are expected to account for nearly 30 per cent of all United States energy requirements by 1985 compared with 12 per cent today.

*0:47* One of the most crucial aspects of the United States energy outlook is the rapidly escalating dependence upon imports of crude oil. It is projected that by 1980 the United States will be importing about 50 per cent of its crude oil supply. The great majority of these imports will originate in the Middle East, and the political and strategic implications of this dependence are a matter of great concern.

*0:48* There is a similar increasing dependence on imports of natural gas although there is much more likelihood that consumption of this particular fuel will be restricted by rising prices and available supply. Already significant shortages are being experienced. In 1970, imports of natural gas to the United States accounted for only 4 per cent of total gas supply. By 1980, assuming foreign supplies can be obtained in one form or another, it is estimated imported natural gas will provide more than 20 per cent of United States gas supply and this ratio could continue to increase. The domestic gas supply is expected to reach a peak within a few years and by 1978 production of gas in the lower 48 States may be below the 1970 level.

*0:49* The United States energy supply outlook will have unavoidable and large implications for Canadian energy policy and, unavoidably, for Ontario energy policy. The most important aspect is the rapidly escalating dependence of the United States on imports. This applies particularly to crude oil but also to natural gas and could conceivably extend to uranium. Apart from the exceptional increases in the volume of imports, security of supply is a further major concern in the United States energy outlook.

*0:50* These circumstances in the United States will bring about a continuing upward pressure on energy prices. Inevitably the United States energy supply constrictions will through their effects on international markets spill over into Canadian and Ontario energy costs. Ontario's most direct link with the United States is in the form of coal imports which account for the bulk of the province's supply. Historically, United States coal has been most reliable in times of emergency and of shortages in other supplies. Ontario's oil and gas supplies and prices are affected strongly although indirectly by United States energy policies and prices, principally through the influence of western Canadian exports of gas and oil to that market.

### iii) Canadian Energy Outlook

*0:51* From an overall standpoint, Canada is self-sufficient in oil and gas production but over the past decade there has been a significant change in market distribution. For example, in 1960 Canadian markets accounted for 78 per cent of Canadian crude oil production. By 1972 this ratio had declined to 46 per cent reflecting substantial increase in exports to the United States balanced by equally large increases in imports into eastern Canada. Ontario is the largest single regional customer for Canadian crude oil production, taking about 25 per cent of total output.

*0:52* The approximate overall Canadian self-sufficiency on crude oil trade account is influenced strongly by the National Oil Policy. These ground rules were set down in 1961 and essentially held that markets west of the Ottawa Valley in Ontario should be served by Canadian crude, principally from Alberta and Saskatchewan. By limiting the westward movement of imported oil, the National Oil Policy in effect ensured a certain minimum security of supply from domestic sources. The measure was thought to be necessary because of the differential between costs of imported and domestic crude, heavily in favour of the former. Without the National Oil Policy and given the past restrictive import policy of the United States, lower cost imported crude would have captured the Ontario market and the Canadian oil industry would not have developed as it did.

*0:53* Another subject of great interest to Ontario is the level of proven reserves in Canada. Over the past three years the Canadian reserve life index has been dropping in contrast to the 1950s and 1960s when reserve additions greatly exceeded annual increases in production. The outlook is for remaining reserves in western Canada to reach a peak in 1972 and thereafter decline from about 10 billion barrels to 8 billion barrels by 1980. The great bulk of these reserves will be in Alberta.

*0:54* From a strategic viewpoint, the most appropriate way to regard estimated reserves is their life index, that is to say, the number of years the volume of reserves would last at current rates of production. For Alberta, the current life index is 21 years. This is expected to drop rapidly however, reaching a level of just over 11 years by 1976.

*0:55* Crude oil production in Alberta is currently 1.4 million barrels per day and this is expected to increase until 1976, reaching 2.2 million barrels per day. Thereafter, production may level off and begin to decline, falling below 2.0 million barrels per day by 1980. The Alberta decline would be much greater but for the increase in synthetic crude production from the Athabasca tar sands, expected by 1976. In fact, future additions to Alberta production will depend heavily on Athabasca tar sands beyond 1980.

*0:56* In view of this apparent deficiency in reserves of oil from conventional sources, great emphasis is now being placed on the development of Canada's oil and gas reserves in remote areas such as the Arctic and offshore. On the basis of present knowledge and forecasts, Canadian markets will require production from these sources by 1980.

*0:57* Production of natural gas in Canada has risen in meteoric fashion since the mid-1950s when major trunk line construction, east and west from Alberta, opened up new markets. Alberta has maintained a dominant role in gas supply producing 85 per cent of the Canadian total. As a result, most gas consuming provinces in Canada, including Ontario, depend in very large measure on supplies from Alberta.

*0:58* In 1970 Ontario was by far the largest single market for Alberta gas, accounting for 29 per cent of the total. The only other markets of comparable significance were the United States east of the Rockies (18 per cent) and west of the Rockies (26 per cent). Alberta's own use accounted for 17 per cent of production in 1970. During the 1960s, gas sales in Ontario increased at an average annual rate of 15.5 per cent.

*0:59* As with crude oil, reserves of natural gas in western Canada have not kept up with expanding markets. As a result, from 53 years of supply in 1960, the reserve life index had declined to an estimated 27 years

by 1971. These estimates refer to the western Canadian sedimentary basin and do not take account of the substantial new reserves of gas being found in the Arctic Rim area. Future gas supply for Ontario is ostensibly protected by the National Energy Board through their "exportable surplus" policy which limits exports to those reserves which are surplus to indicated Canadian requirements over a 25-year period.

*0:60* Coal is the most abundant fossil energy resource in Canada, and 93 per cent of coal reserves are located in Saskatchewan, Alberta and British Columbia, remote from present markets in Ontario, which are closer to United States coal. As a result, two-thirds of Canada's coal for consumption is imported from the United States. Offsetting this, however, western Canadian coal has recently established substantial export markets in Japan. Domestic production of coal in 1970 was 17 million tons, of which five million tons were dedicated to export. Imports, on the other hand, reflecting consumption in Ontario, amounted to 20 million tons.

*0:61* Future coal demand in Canada will depend largely on thermal generating requirements for electric utilities and coal for coking principally in Ontario and Alberta. By 1980, Canadian demand for coal could approach 50 million tons of which 20 million tons are likely to be met by imports from the United States. Depending on the progress of research, primarily in the United States, it is possible during the 1980s that coal will be used to produce synthetic gas or even liquid fuel. Canadian coal reserves, most of which lie in western Canada, are close to 10 billion tons. Indicated and inferred reserves total 118 billion tons, however, most is not recoverable economically with present day technology. These reserves are buried beneath thick glacial deposits or are severely faulted and folded.

*0:62* The energy supply outlook therefore is characterized by important features which are both uncertain and unfavourable for Ontario as contrasted with the past. World oil demand is rapidly depleting known resources. In the United States all energy resources are coming under increasing supply pressures which are causing shifts between fuels and bringing about higher prices. The effects of the United States energy shortages are being felt in Canada, especially through price pressures. In western Canada the proven reserves of both oil and gas are expected to level off during the next few years and then to decline.

## THE OPTIONS FOR ONTARIO'S ENERGY SUPPLY

*0:63* What are the available options? We need to look at the Athabasca tar sands, Canadian frontier resources in the Arctic and offshore, and nuclear power.

*0:64* The Athabasca tar sands are estimated to contain more than 300 billion barrels of recoverable oil, one of the world's largest known reserves. Currently one plant is in production at a rate of 50 thousand barrels per day and another is due to come on stream by 1976 if arrangements with the Alberta Government can be agreed upon. If Alberta is to offset declining conventional production by increased synthetic output from the tar sands, one new plant costing altogether about $750 million would be required each year. With the long construction periods of these units, four or five would have to be under construction at a time. It is doubtful if the engineering and construction capability can be mustered to maintain this level of activity. The capital investment required would be enormous. It is unlikely therefore that production from the Athabasca tar sands will be able to meet the entire increase in Canadian requirements for crude oil in the early future, although it could make a welcome addition to supply.

*0:65* Frontier resources are, by definition, "North of 60°" or offshore in the oceans. The key characteristics of these sources are high costs of exploration and development and long distances from markets.

*0:66* Another important factor is the very large volume of oil and gas which has to be moved to justify the economics of the immensely costly pipelines. The market must be large enough to absorb the initial large volumes which are needed for this purpose.

*0:67* There is no doubt that these frontier resources will eventually be needed for Canada's markets. Proven reserves of both oil and gas from conventional sources will not be sufficient to sustain growth in domestic demand beyond this decade. Thereafter, frontier production will be needed. But first the reserves must be established and this cannot be done without heavy expenditures on exploration and development in the near future.

*0:68* As the oil and gas production from the western sedimentary basin levels off in the mid 1970s and greater emphasis is placed on frontier resources, the centre of policy influence will swing from the provincial level to the federal level, these frontier resources being under federal jurisdiction and influence in one way or another. This means that should Canada want to move toward an integrated national energy policy the change would be greatly facilitated because of the increasing influence of federal policies on the production of oil and gas.

*0:69* One important implication of frontier resource development is the impact on production costs and market price. In all respects the energy outlook points to the likelihood that energy costs and prices are going to increase steadily over the next decade. However, the quantum leap from production in the prairies to production on the distant frontiers is so

great that a substantial increase in energy prices can be expected from this move alone. Meanwhile, prices of oil and gas in the conventional producing areas are expected to escalate steadily through the 1970s in the anticipation of the new costly sources of supply which will have to be brought in by the end of the decade.

*0:70* While most frontier interest has recently centred on the Arctic Rim development, attention should be paid also to the East Coast offshore play where substantial sums of money are being invested in offshore drilling. In this hostile environment, as indeed in the Arctic Rim, the development companies have to establish substantial thresholds of reserves before they can justify the expensive development and production costs. In the Mackenzie Delta, the geology of the reservoirs has proven to be more predictable and is potentially prolific. Offshore in the Atlantic, however, while the sedimentary potential is there, initial geological findings suggest that the reservoirs are complicated and hence will be expensive and less predictable to develop.

*0:71* However, the strategic significance of oil or gas production off the Atlantic Coast would be very considerable. Arctic Rim oil and gas moving from the general direction of west to east would augment existing flows of energy supply based originally on Alberta-Saskatchewan resources. Oil or gas production from the East Coast, however, would enter eastern Canada, and eventually Ontario, from a different direction introducing a new source of supply and a new price influence. In fact, the price of offshore oil or gas in Ontario would be designed to meet competition from western Canada. Also, if production levels warranted, the United States would provide a very hungry market for oil or gas from the Atlantic Coast. In the United States the shortages are so much greater that the physical availability of these supplies is likely to be highly welcome.

*0:72* For nearly twenty years, a substantial Canadian nuclear research and development program has been devoted to the objective of producing economical nuclear power utilizing natural uranium, heavy water moderated, reactors.

*0:73* The Canadian nuclear reactor system is now recognized internationally as one of the world's most promising – a reputation which at the time of writing is being confirmed by the outstanding performance of the 2.2 million kilowatt nuclear station at Pickering. The performance of this station to date has not been exceeded by that of any other nuclear station in the world. In 1971 nuclear power accounted for 5 per cent of the electricity generated by Ontario Hydro. By 1980 it is expected that more than 25 per cent of electric power demand will be supplied by nuclear stations and more than 50 per cent by 1990.

*0:74* The continued success of the Canadian nuclear program will mean that we have a power source which draws on an abundant source of indigenous fuel – uranium. The uranium ore reserves in Ontario which can be produced at prices not exceeding $10 per pound are estimated at 190 thousand tons. While large (more than 15 per cent of total world reserves) in comparison with today's demand, the Ontario reserves are not large in comparison with the expected world annual demand by the mid-1980s of 140 thousand tons. Many countries will have large nuclear power programs and accordingly world demand for uranium is expected to outrun the supply. Ontario nuclear power stations built in this decade will require an estimated 75 thousand tons of uranium during their lifetime. The protection of these requirements as well as the development of additional reserves are matters which warrant attention.

*0:75* Nuclear power will help to conserve Canada's fossil fuel reserves and free them for other uses. Ontario will be less dependent on sources of fuel outside the province for the production of electricity. Ultimately, it should facilitate greater stability in electricity costs and rates, and it seems possible that it will be more environmentally acceptable than fossil fuel generating stations.

*0:76* Canada's natural uranium, heavy water reactors also have the advantage from the point of view of fuel conservation, that they produce more than twice as much electricity from each pound of uranium mined than the enriched uranium reactors of the United States. The capital costs of the Canadian system are higher, but their fuel costs are much lower and therefore overall costs of energy will be less sensitive to the effects of continuing inflation. In the space of about fifteen years, the Canadian nuclear power program has developed into an industry employing many thousands of people and involving an estimated investment of $4 billion, mostly in Ontario.

*0:77* It is clear that the continued development of nuclear power should continue to play a large role in meeting Ontario's energy needs and problems during the next several decades. Indeed it could be a decisive factor for Ontario in a world of growing scarcities in the supply of energy.

## PROBLEMS AND IMPLICATIONS

### Energy Costs

*0:78* Two major factors of change have been observed in the past few years. First are the cost-price trends. During the last two decades worldwide energy costs remained relatively stable but recently this position has

changed dramatically. Worldwide demand has accelerated for all types of energy and has moved to more costly forms of energy consumption. On the supply side, the closure of the Suez Canal and the increased pressure for larger royalties has increased Middle East crude oil prices substantially. Although the oil industry has learned to live without the Suez Canal, there is every indication that the large producing countries will continue to increase the price of oil.

*0:79* An important energy supply constraint has been the failure of the United States nuclear power program to meet its planned objectives. This was partly due to technical problems, but also due to environmental controls restricting the rate of construction and the operating levels of existing plants. By 1970, the United States natural gas industry was not able to meet the demand. The wellhead price controls instituted in 1954 were believed responsible, by reducing the incentive to find new reserves. Combining these demand-supply factors, it is hardly surprising that world energy prices began to rise. These increases are now being reflected in the United States, Canada, Alberta and in Ontario. Ontario, being at the end of the pipeline, has been the last to receive these demand-supply pressures. This deferment however means that a substantial degree of adjustment is still in store and lies immediately ahead.

*0:80* The combination of these multifarious supply-demand and related environmental factors have set the stage for the complex energy scenario of the 1970s. It will no longer do to merely project the historical series of the 1960s and expect "the same again" in the following decade. The 1970s should in fact see the transition from the "pre-environmental" to "post-environmental" eras when the costs of protecting the environment and of maintaining in an acceptable way the quality of life, will be taken up. By the 1980s the technical problems of environmental controls will have been resolved more fully and the energy economy will have become reconciled to a new level of costs and prices associated with necessary environmental controls.

*0:81* It has already been indicated that energy costs and prices in Ontario are likely to move steadily upward over the foreseeable future. The reasons for this upward shift originate both on the demand side of the equation as well as on the supply side. Increased energy consumption is synonymous with economic growth, and even the objectives of environmental improvement imply in a number of cases increased energy use. The demand for energy is increasing with gross national product, higher living standards and improvements in the quality of life. On the other side of the equation, supply constraints originating in the United States have introduced supply bottlenecks which have had the effect of increasing energy costs.

*0:82* The supply problem in the United States originated initially in natural gas wellhead pricing controls but more recently environmental awareness has slowed down the construction of new energy facilities such as oil refineries, deep water ports for super tankers and nuclear plants. All these have tended to impair supply, and added price pressures which have radiated throughout the entire North American energy economy.

*0:83* Little help can be expected in the short term for the solution to the energy supply problem through restricted consumption as a result of increased prices. In the longer run, however, this may be more effective especially in terms of redistributing demand for energy between end uses. Thus demand by industrial users for certain premium types of energy such as natural gas, will be reduced as prices rise. However, the demand for other energy forms such as coal and oil will increase, and so will the pressure on their prices.

**Capital Requirements**

*0:84* The new sources of energy which will be called upon are all highly capital intensive and great demands will be placed on Canada's financial markets to meet these requirements.

*0:85* Ontario's energy capital needs are dominated by the role played by external sources of energy in the provincial supply. A capital study confined to energy indigenous to the province merely touches the surface of the problem. However, as Ontario moves more and more to nuclear power, the role of capital provision within the province will increase substantially.

*0:86* The subject of energy capital requirements has reached the stage in public debate where concern is being voiced about the ability of the Canadian economy to provide the necessary capital and, further, to withstand some of the possible impacts on the balance of payments. A preliminary estimate of the capital requirements for all Canada's energy industries for the balance of the decade is $60 billion (1972 dollars). Of this total, roughly 40 to 50 per cent will be required by the electric power industry, new generating facilities accounting for approximately two-thirds and transmission facilities one-third. Approximately $15 billion will be required by the petroleum industry and $15 billion by the natural gas industry.

*0:87* The Mackenzie Delta gas pipeline is presently the focus around which most of this debate revolves. This project is variously estimated at $5 billion to $6 billion. Other major capital projects of equal or even larger scale such as the James Bay hydro project and a second Arctic

pipeline are coming on the scene. It has been assumed in this estimate that the James Bay development will cost $6 billion with initial outlays beginning in 1974.

*0:88* The magnitude of these requirements has caused great concern in many quarters when related to the questions of Canadian ownership and to questions concerning the effect on the balance of payments and the impact on the value of the dollar. Until specific details are available on individual major projects (for example, the proposed import content of a Mackenzie Delta line), it is not possible to assess the likely impact of these requirements in detail.

*0:89* However two qualifying points should be made. First, these capital requirements must be related to the policies which will be adopted regarding both exports of energy and imports of equipment and supplies. It all depends on the timing and balance between these factors. Second, these are gross requirements and do not make allowance for the funds which can and will be generated internally by the participating companies. Estimates of this capability vary between 30 per cent and 40 per cent of total requirements.

*0:90* Finally, relating these gross requirements to GNP in constant dollars, we have a better indication of the ability of the Canadian economy to accommodate these volumes. Assuming the real GNP to increase at an average rate of 5 per cent, the annual capital requirements for energy will average 5.5 per cent of GNP for the balance of the decade. The ratio increases from 4 per cent in 1973 to a peak just over 7 per cent of GNP in 1976 and 1977 to coincide with the maximum levels of activity for the proposed Mackenzie Delta line on the timetables now being proposed. Thereafter the ratio declines but will be maintained by new major developments such as James Bay, and an oil pipeline from the Arctic Rim. Undoubtedly these large demands will require the careful formulation of coherent financial, trade, and development policies at the national level – policies which are consistent with national objectives.

*0:91* The significance of these large Canadian energy industry capital requirements to the province of Ontario is based on our heavy dependence upon energy from distant places, specifically oil and gas from western Canada and later from frontier sources. The financing of the development of these energy sources will have a direct bearing on the Ontario energy supply.

*0:92* Ontario's energy industries have their own capital needs, largely based on the requirements of Ontario Hydro. Combining Hydro's requirements with estimates for the other energy industries, the total Ontario capital needs will average roughly $1 billion per year for the decade. This is approximately 13 per cent of the Canadian total as estimated here.

By comparison Ontario's energy consumption represents 35 per cent of the Canadian total. This is another reflection of the province's dependence upon external energy sources and, as a corollary, upon external capital expenditures.

### Energy Policy

*0:93* Ontario's energy policy options are limited because of the province's large dependence on external energy supply. Within the federal context, Ontario is highly dependent upon and inextricably involved with federal and interprovincial policies. In the wider North American sphere, Ontario is also deeply affected by economic and energy policies originating in Washington, for reasons which have already been stated above. Even by 1990, when Ontario's nuclear program should be well advanced, the province would still be 70 per cent dependent upon imported energy.

*0:94* Such key matters as the present availability of natural gas and crude oil come under the jurisdiction of other provinces (specifically Alberta), and the federal government. Interprovincial movement of oil or gas by pipeline is a federal matter. The availability of natural gas for Ontario is subject to exportable surplus calculations by Alberta and the federal government. Indeed, the only protection enjoyed by Ontario on gas supply is the determination of domestic requirements upon which the National Energy Board bases its exportable surplus calculation.

*0:95* In the case of imported coal, Ontario must depend upon United States authorities which could conceivably restrict supply at some future date. However, the security of supply of United States coal has been most commendable in the past, even in the face of supply constraints in the United States.

*0:96* Ontario, therefore, finds itself in a rather unusual position of being one of North America's most energy intensive regions, and yet one of North America's most energy deficient regions comparable in many ways to New York State.

## THE NEED FOR A POSITIVE POLICY OF EFFICIENT USE, CONSERVATION AND RESEARCH

*0:97* Thus far the emphasis of our summary has been on establishing the likely conditions of future supply of energy for the province and the changing circumstances likely to be encountered in the future. Much of our attention has been centred on supply. But there is an equally effective approach to the matter of energy and that is to improve the efficiency with

which energy is applied and to promote the conservation of its use. Moreover, the terms and conditions of energy consumption are matters over which the province has jurisdiction and can effectively assert a strong influence.

*0:98* Improving the efficiency of energy use has two desirable consequences. Firstly, since less fuel is consumed in order to perform useful work, there is a net conservation of fuel. Secondly, environmental degradation is reduced, since environmental impact is roughly proportional to the amount of fuel extracted, transported and consumed. The rapid exponential growth in the production, transportation, conversion, and the use of energy, involves large disturbances in the natural environment and large emission of wastes and pollutants into the air and water. Increasingly, these disturbances and emissions have reached a scale in particular locations and circumstances which exceeds the capacity of natural processes to cope with them. Whenever this happens, valuable resources and amenities may be destroyed and the quality of life degraded. Consequently, policies and programs concerning the development and use of energy must have adequate and timely regard for environmental considerations. In future, these considerations must occupy an appropriate place of priority in all planning and decision-making concerning energy, alongside convenience, availability and cost. Environmental issues must no longer be approached as an afterthought or as matters to be "cleaned up" after the event. They must be taken fully into account and dealt with from the very beginning.

*0:99* The size and nature of the energy market make it unlikely that consumption practices will change quickly. However, there are major areas of energy use where greater efficiencies should be an early objective. In the residential field: improved insulation and better furnace efficiencies; in transportation: inter city passenger and freight movements, urban transit systems to replace the private automobile, and more efficient automobile engines; in manufacturing: more efficient industrial application; and in electric power: improving the efficiency of thermal stations and finding applications for the waste heat.

*0:100* Once a policy of improving energy efficiency has been established many opportunities for significant savings and environmental improvements will follow: better engine tuning, removal of tax discrimination against the use of cleaner fuels in engines, e.g., propane, recycling and reuse of materials, shifting electric and natural gas loads to off-peak hours. The mass consumption of energy can over time be affected by wide public awareness brought about by government leadership.

*0:101* Obviously, application of improved technology to space heating problems offers the greatest scope for economy in energy use in the residential-commercial sector. Energy-saving possibilities include improving

the efficiency of conventional home furnaces; reducing heat losses from convection, conduction and infiltration; and introducing more efficient heat production and storage devices.

*0:102* A variety of energy conversion and storage technologies applicable to groups of buildings instead of single structures, are in an advanced stage of development but are not in general use. These include heat pumps, heat storage devices, total energy systems and district heating.

*0:103* It has also been estimated that if year-round efficiency could be increased to 75 per cent and applied to all furnace units in the province, then overall fuel requirements for this purpose could be reduced by about 15 per cent. On the assumption that most older furnace units could not readily be made more efficient, it is more reasonable to calculate the effect of an overall efficiency increase of, say, 5 per cent. A saving of as little as 5 per cent by 1980 would mean a fuel-saving equivalent to 30 billion cubic feet of gas or 180 million gallons of oil.

*0:104* It is recognized that in the short run certain programs will work against energy conservation. Removing lead from gasoline and adding emission control equipment will increase the consumption of gasoline. Restriction of sulphur content will limit the available supply to low sulphur coal and oil, and will increase refining costs and require installations of equipment to remove sulphur from stack emissions.

*0:105* The trend to more conservative energy use by industry will be prompted and accelerated as energy costs rise. In the past, industrial and domestic customers in Canada have taken energy for granted; so much so, that it has almost been regarded as a free commodity, and this without reference to the social costs of using that energy. As costs and prices increase, Canadians at all levels will be induced to conserve and be less wasteful in energy use. By concentrating on the more efficient utilization of our energy resources, direct curtailment of essential demand will be avoided.

*0:106* Many essential issues have been raised that call for early attention. There is need for additional research, both physical and social, to provide not only solutions to problems of pollution but also better insight and understanding of the issues. Research leading to the better end-use of energy (improved efficiencies) in all major end-use categories residential, industrial, transportation, and conversion (electricity) could be of substantial value. In addition, the province should be interested in giving support to major technological developments that in the long run could reduce our dependence on distant supply sources.

*0:107* Improved social and economic research will enable the province to better anticipate emerging energy problems, assist the provincial

authorities to evaluate the alternatives and provide a basis for provincial energy policy.

## FEDERAL-PROVINCIAL ENERGY RELATIONSHIPS

*0:108* The task of energy policy formulation in Ontario is constrained by the relationship between federal and provincial energy jurisdictions. The dominance of federal involvement in the energy sector is based on its jurisdictional authority in the areas of interprovincial and external trade. The position of the federal government is augmented by its ownership of mineral rights in the Territories, plus jurisdiction over specific strategic minerals such as uranium. As a result, the federal government controls key energy policy and energy regulation in the vital areas of resource management and trade. It controls access to markets by domestic producers and foreign suppliers and access to supply by domestic consumer and foreign buyer, by virtue of its regulatory authority over pipelines crossing interprovincial and international boundaries.

*0:109* Of key importance in the future is the federal government's jurisdiction over hydrocarbon resources in the frontier areas of Canada. As has been indicated, these will become of increasing strategic significance in future supply. While the federal government plays a central role in the control of energy supply from producing regions, all provinces play the dominant role in consumption of energy, that is, internal distribution and utilization. Gas and electric utilities are subject to provincial regulation for sales within a province either by direct control or privately owned utilities or by means of outright public ownership.

*0:110* There is little doubt that over the next few years there will be a substantial change in federal-provincial energy relationships. This is due partly to the changing balance of power in terms of energy supply which also reflects changing geographical emphasis. For the past two decades the Province of Alberta has dominated Canadian hydrocarbon energy supply. Within the next ten years the centre of gravity is going to be diffused and the frontier areas will detract from the predominant role which Alberta has played. This will greatly increase the energy policy role of the federal government in hydrocarbon supply.

*0:111* The balance between federal and provincial energy policies is likely to move towards the federal government on yet another count, that is, the growing complexities of the international aspects of Canadian energy policy, including relations with the United States. Canada as a whole and hence the federal government will inevitably become more heavily involved with United States energy attitudes and decisions. If this is so, then more

weight will swing towards Ottawa in energy matters. With this greatly increasing concern of energy policy at both the federal and the provincial levels, the province of Ontario will be faced with the necessity of enunciating and developing a coherent energy policy of its own. Over the next few years Ontario will have to develop specific postures regarding natural gas, crude oil, coal and uranium. Only by developing a coherent provincial attitude on these matters can the province adequately present its position at the federal level, from where many of the vital energy policies are going to emanate in the future.

## APPENDIX A

## BIBLIOGRAPHY OF INTERNAL RESEARCH REPORTS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## BIBLIOGRAPHY OF CONSULTANTS RESEARCH REPORTS

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## APPENDIX C

## ORGANIZATIONS FROM WHICH SUBMISSIONS WERE RECEIVED

Canadian Commercial Coal Dock Operators Association
Canadian Industries Limited
The Chemical Institute of Canada
The Conservation Council of Ontario
The Consumers' Gas Company
Dow Chemical of Canada, Limited
Engineering Institute of Canada, Hamilton Branch
Farmers' Gas Company Limited
Firestone Tire & Rubber Company of Canada Limited
Gulf Oil Canada Limited
The Hydro-Electric Power Commission of Ontario
Imperialle Fuels Co. Limited
Imperial Oil Limited
Long Beach Private Property Owners Association
New Metalore Mining Company Ltd.
Northern and Central Gas Corporation Limited
Ontario Fruit and Vegetable Growers' Association
Pollution Probe at the University of Toronto
Polymer Corporation Limited
Propane Gas Association of Canada
Ram Petroleums Limited
Shell Canada Limited
Sierra Club of Ontario
Texaco Canada Limited
TransCanada PipeLines Limited
Union Gas Company of Canada, Limited
Universal Terminals Ltd.

## APPENDIX D

## INDIVIDUALS FROM WHOM SUBMISSIONS WERE RECEIVED

| | |
|---|---|
| Adey, R. | Oakville |
| Bardawill, Victor G. | Aylmer |
| Burgess, John D. | Union |
| Goering, Jack W. L. | Port Hope |
| Hatley, James J. | Orillia |
| Hoes, P. J. | Peterborough |
| Johnson, Arthur C. | Ithaca, N.Y. |
| Taylor, John L. | Kingston |
| VandenHazel, B. J. | Woodstock |

## APPENDIX E

## DISSENTS BY DR. ROBERT H. HAY

Dissent by Dr. Robert H. Hay from sub-paragraph 00:5 d) page iii

1. Notwithstanding all explanations and avowals of intent, nothing in the wording of the paragraph will prevent its interpretation as authority to regulate Ontario Hydro's rates and financial programs, particularly when this paragraph is read with paragraph 00:5 e) which assigns rates regulatory power and function to the proposed Commission and with paragraph B 00:6 f) which describes its duties and functions after the creation of a Ministry of Energy.

2. It requires that one Government Commission, presumably autonomous and independently responsible to the Cabinet, be subservient to another Commission and it will thus compound the possibility of bureaucratic delay, procedural complexity, diffusion of responsibility and duplication of oversight and advice to Cabinet.

3. The paragraph is completely inclusive. The burden thus created will have one of two consequences. Either the review would very quickly become perfunctory and therefore quite useless or the regulatory function and procedures will rapidly become an intolerable bottleneck in the way of orderly, timely and adequate provision of electrical energy.

Dissent by Dr. Robert H. Hay from Recommendation C. 00:7, page v

There is no measure of environmental damage yet available for such assessment nor can we yet be sure what will comprise a complete list of possible environmental and social consequences, both good and bad, of a given energy program or project. The determination of the measure of damage and development of reasonable standards which recognize the need for "trade-offs" must come first if we are to avoid the confrontations inherent in the "risk-free" environment position which can follow so easily from the recommendation as it now stands.

## APPENDIX F

## LETTER FROM HENRY A. REGIER

probe Pollution Probe at the University of Toronto, Toronto 181, Ontario

December 19, 1972

Dr. J. Deutsch
Chairman, Advisory Committee on Energy
4th Floor, Mowat Block
Queen's Park
Toronto

Dear Dr. Deutsch:

I have discussed the contents of Volume 1 in depth with my colleagues in Pollution Probe and we wish to make the following points:

1. Since its creation, effectively in August, 1971, the Advisory Committee on Energy seems to have been swept along in a tide of events that the Committee as such has perceived only dimly. Perhaps it was largely overcome by that tide. We feel that it should have struck a course and produced a different kind of report, based on different assumptions and dealing with additional topics.

2. Pollution Probe's submission to the Committee, dated July, 1972, contains an extended series of major points that we feel should have been taken up into the report. We felt that others on the Committee were sympathetic to many of our concerns and a broad consensus might already exist in some of them. Probe's July 1972 brief will serve as the basis for our minority report.

3. We cannot of course comment on the contents of Volume 2 before the revised draft is available to us for study. Pollution Probe suggested extensive changes in the first draft to correct for errors, omissions and biases. We may issue a further report when the Committee's Volume 2 becomes available.

4. We judge that the Committee's two major recommendations would in any case have become government policy in 1973 or 1974. The "energy crisis" building south of us and the "environmental awareness" now rapidly permeating our society would have in themselves dictated these responses. The main contribution of our Committee may thus have been to

shorten the lag period between widespread recognition that a major political problem has developed, and the initiation of an effective governmental response to it.

5. Volume 1 fails to specify to our satisfaction the objectives and direction for an Ontario energy policy, and the structures and mechanisms proposed here do not ensure that the objectives which we favour will be met. For the proposed Ontario Energy Commission, the qualifications and loyalties of the five full-term members are not specified. Opportunity for effective public involvement should be assured, and not left to the "discretion" of the Commission.

6. Much as we in Ontario need strong institutions to deal with energy matters and a full and fair accounting of environmental values in major undertakings, these alone will not solve even our medium-term problems. We are much concerned about conventional growth. The rather automatic assumptions of high growth rates – of the population, "economy", and eventually of energy usage – made by the Committee's analysts may, we fear, serve to stimulate far more social and capital investment into energy development than will be necessary. A predicted high rate of growth may serve to encourage that growth, and the prediction may thus become self-fulfilling.

7. Analysts now commonly use a series of alternate assumptions where future events are quite uncertain. In spite of our explicit requests for alternatives on growth assumptions, the Committee's analysts did not provide these. Thus, the analysts have failed the Committee, and other readers of this report, in that they have not developed a context in which to consider the implications of possible changes in major policies on the "growth of the economy".

8. Pollution Probe explicitly dissociates itself from all those parts of the report that follow from the assumptions that high growth rates in energy consumption will continue for several decades. Unquestioned acceptance of extrapolations of demand, from past levels that were continually stimulated by entrepreneurial boosters, is hopefully a thing of the past. Government must by now realize that its mandate includes the right and also the obligation to deal with demand mechanisms. The high levels of supply seemingly dictated by the predicted runaway demand may well be trimmed to quite manageable proportions with some appropriate institutional mechanisms that will influence demand directly. We find it distressing that the ACE report has so little to suggest on these matters, since Pollution Probe emphasized them so strongly in its brief. We had understood that a broad study on the consequences of continued growth would be recommended by the Committee, but this recommendation does not appear.

9. We hope, therefore, that those parts of the ACE report that follow from assumptions of vastly increased consumption will be read as an unpleasant scenario that need not happen if appropriate policies are developed and implemented with dispatch.

10. These points were raised repeatedly during the past year both as written submissions and during Committee meetings. These problems now face the people of Ontario and the report contributes little to their resolution.

Sincerely yours,

Henry A. Regier

HAR:JS